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(71) Applicant
Bergische Stahl-Industrie
(Incorporated in FR Germany)

Papenbergerstrasse 38, 5630 Remscheid,
Federal Republic of Germany

(72) Inventor
Josef Kunnen

(74) Agent and/or Address for Service
Dr Walther Wolff & Co
6 Buckingham Gate, London, SW1E 6JP

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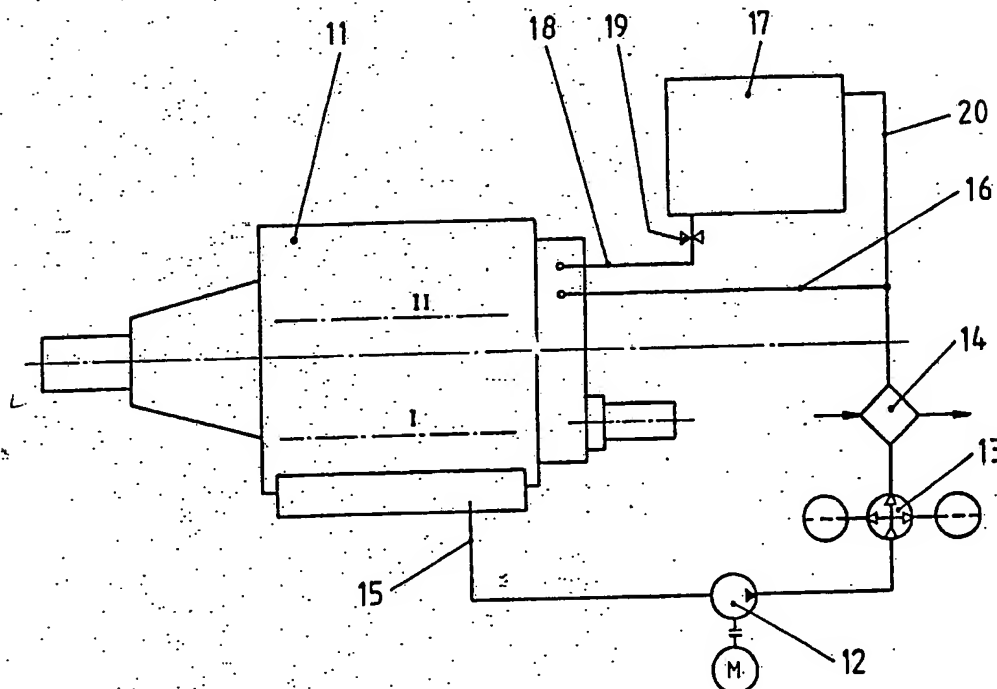
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(54) Lubrication of gear means for a wind energy installation

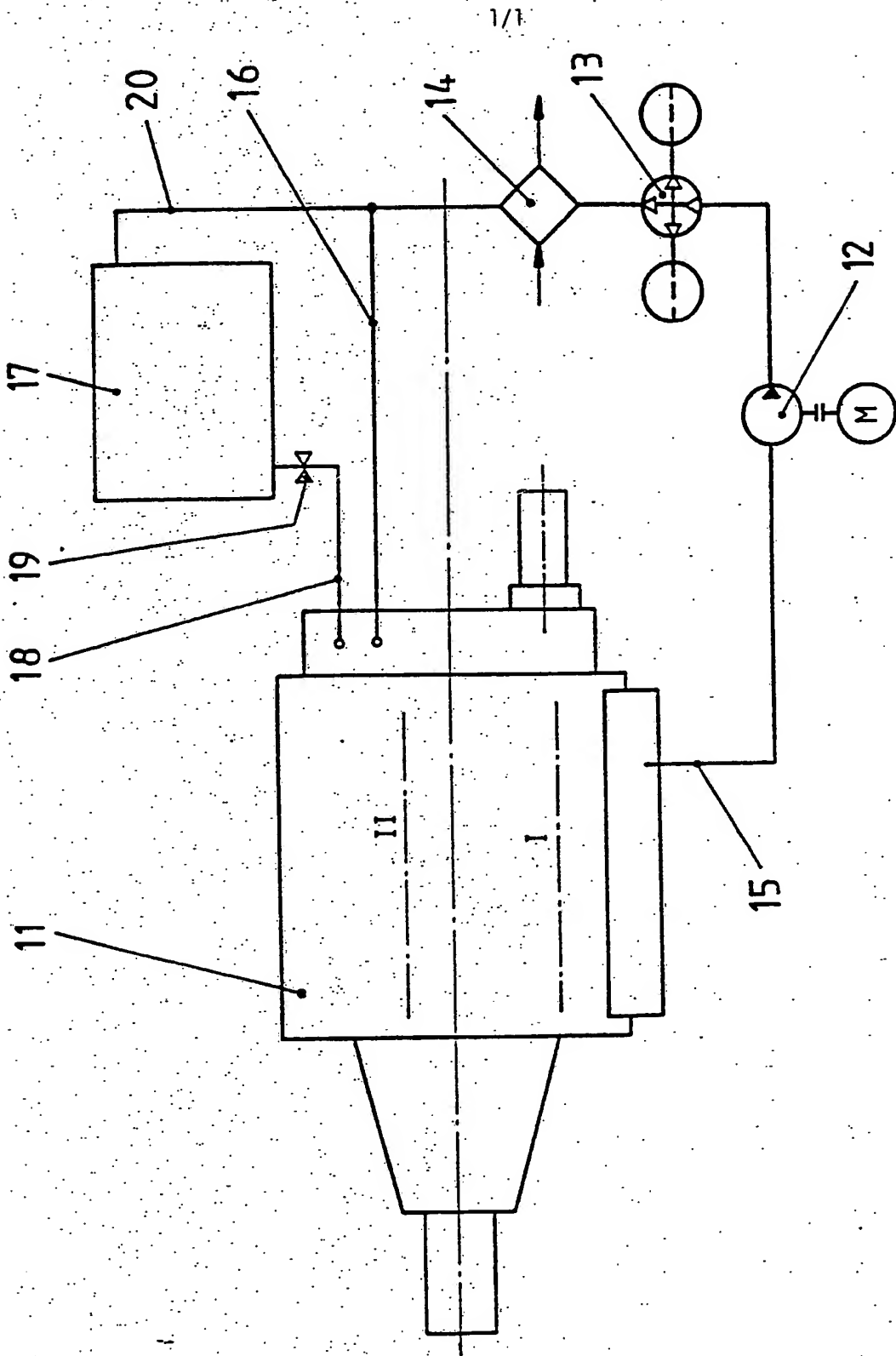
(57) A method of lubricating gear means for a wind energy installation comprises the steps of maintaining operational lubrication by an oil-circulating system (12 to 15) with injection lubrication, with the oil being cooled at the same time. The normal height (I) of the oil level in the gear means casing (11) is increased to a height (II) necessary for splash lubrication when the rotational speed of the gear means falls below a settable value. To increase the height of the oil level, an additional quantity of oil is fed to the casing (11) from a reservoir (17).



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LUBRICATION OF GEAR MEANS FOR A WIND ENERGY INSTALLATION

The present invention relates to a method of lubricating gear means for a wind energy installation and to drive means for such an installation.

5 The gears of wind energy installations are provided with injection lubrication for reasons of efficiency because of losses in splash lubrication and also to allow heat removal in an oil-circulating system. Splash lubrication has proved to be too expensive and energy-consuming. However, since installations of that kind are switched off when, for
10 example, the wind is weak and then constantly carry out tumbling motions, the rolling bearings and gear toothings would be without lubrication and thus subject to considerable wear.

There is thus a need to overcome the disadvantages of injection lubrication and yet to retain the advantages, in particular by main-
15 taining lubrication even when oil injection no longer functions due to switching-off of the installation.

According to a first aspect of the present invention there is provided a method of lubricating gear means for a wind energy installation, the method comprising the steps of circulating lubricating oil
20 through a casing of the gear means by way of a circulatory system in which the oil is injected into the gear means and removed from the casing with maintenance of the level of oil therein at a predetermined height, and so feeding an additional quantity of oil to the casing when the rotational speed of the gear means falls below a settable
25 value as to increase the level of oil in the casing to a height permitting splash lubrication of the gear means.

In a preferred example of the method, operational lubrication

is maintained by an oil-circulating system with injection lubrication and the oil is at the same time cooled in the circulating system. The normal oil level in the gear means casing is brought to a height necessary for splash lubrication when a settable rotational speed is
5 fallen below, in which case the additional quantity of oil required for this is fed to the casing.

Preferably, the method comprises the steps of removing the additional quantity of oil from the casing when the rotational speed of the gear means rises above a settable value thereby to return the
10 level of oil in the casing to the predetermined height, and delivering the removed quantity of oil to a reservoir, the step of feeding the additional quantity of oil to the casing comprising removing oil from the reservoir. The additional quantity of oil is taken out of the reservoir, into which the quantity of oil, that becomes free during
15 the lowering of the oil level to normal height, is fed back again.

The advantage of such a method is clearly apparent: the gear means with its teeth and bearings lies in oil even when the wind energy installation stands still, so that damage due to non-lubrication may be avoided.

20 According to a second aspect of the present invention there is provided drive means for a wind energy installation, the drive means comprising gear means for the installation and lubricating means to provide lubrication of the gear means and comprising a circulatory system for circulating lubricating oil through a casing of such gear means, the circulatory system comprising injection means for injecting
25 the oil into the gear means and removing means for removing oil from the casing with maintenance of the level of oil therein at a predeter-

mined height, and feeding means for so feeding an additional quantity of oil to the casing when the rotational speed of the gear means falls below a settable value as to increase the level of oil in the casing to a height permitting splash lubrication of the gear means.

5 Preferably, the lubricating means further comprises a reservoir, the removing means being operable to remove the additional quantity of oil from the casing when the rotational speed of the gear means rises above a settable value thereby to return the level of oil in the casing to the predetermined height and further operable to deliver
10 the removed quantity of oil to the reservoir, and the feeding means being operable to remove oil from the reservoir for feeding of the additional quantity of oil to the casing.

For preference the removing means is connected by a delivery duct to the reservoir and by a bypass duct to the injection means, and the
15 feeding means is connected to the reservoir by flow control valve means.

Preferably, the reservoir is arranged at such a height relative to the casing as to permit gravity feed by the feeding means from the reservoir to the casing.

An example of the method and an embodiment of the apparatus of
20 the present invention will now be more particularly described with reference to the accompanying drawing, the single figure of which is a diagram of drive means embodying the invention.

Referring now to the drawing, there is shown drive means for a wind energy installation, the drive means comprising gear means
25 arranged in a casing 11. The oil level I is normally present in the casing 11 and the lubrication is so maintained by an oil-circulating system that the oil is sprayed at the loaded places. The oil-circulating

system comprises a pump 12, a filter 13 and a heat exchanger 14. The oil is drawn off through an outlet duct 15 from about the lowest point of the casing by the pump 12, pumped through the filter 13 and the heat exchanger 14, passed by way of a duct 16 back to the casing 11 and, distributed in known manner, injected into the gear means by injection means (not shown). A reservoir container 17 is arranged with a bypass in the oil-circulating system, in particular connected by a duct 20 to the heat exchanger 14 and by a duct 18 with a throttle valve 19 to the casing 11. The reservoir container 17 is disposed at a higher level than the casing 11.

In normal operation of the wind energy installation, the valve 19 is wholly or at least largely closed and the pump 12 pumps the oil through the filter 13 and the heat exchanger 14 by way of the duct 20 into the reservoir container 17 until this is full. The oil is then sent by way of the duct 16 into the casing 11 at the individual injection places. The normal oil level I is then established by this oil. If the wind energy installation stands still due to the absence of wind, then the valve 19 is opened by way of a monitoring mechanism or an electronic monitoring system, whereby the oil collected in the container 17 flows by gravity into the casing 11 until the oil level II is attained. Since the wind energy installation substantially stands still, the pump 12 can no longer operate so that no oil is pumped into the container 17. In this state, the gear means can absorb the tumbling movements without damage at least in respect of lubrication, because the oil level II is of such height as to allow splash lubrication of the bearings and teeth of the gear means.

If the wind energy installation starts to run again when sufficient

wind is present, then the valve 19 is closed and the pump 12 again conveys oil into the container 17 until this is completely filled.

The oil level I is again attained in the casing and the gear means is lubricated by injection. It can thus operate uninfluenced by the energy losses of splash lubrication. This cycle can repeat as often as necessary.

The reservoir container 17 can, of course, be arranged in a different position, in which case it is necessary to ensure that the oil in the reservoir container is fed into the casing, for example by being pumped, when the wind energy installation stands still. The height of the two oil levels in the casing is easily determined and depends on, in particular, the kind of gear means and size thereof.

CLAIMS

1. A method of lubricating gear means for a wind energy installation, the method comprising the steps of circulating lubricating oil through a casing of the gear means by way of a circulatory system in which
5 the oil is injected into the gear means and removed from the casing with maintenance of the level of oil therein at a predetermined height, and so feeding an additional quantity of oil to the casing when the rotational speed of the gear means falls below a settable value as to increase the level of oil in the casing to a height permitting
10 splash lubrication of the gear means.

2. A method as claimed in claim 1, wherein the method comprises the steps of removing the additional quantity of oil from the casing when the rotational speed of the gear means rises above a settable value thereby to return the level of oil in the casing to the predetermined
15 height, and delivering the removed quantity of oil to a reservoir, the step of feeding the additional quantity of oil to the casing comprising removing oil from the reservoir.

3. A method as claimed in either claim 1 or claim 2, comprising at least one of the step of cooling the oil and the step of filtering
20 the oil in the circulatory system after removal from the casing and before injection into the gear means.

4. A method as claimed in claim 1 and substantially as hereinbefore described with reference to the accompanying drawing.

5. Drive means for a wind energy installation, the drive means comprising gear means for the installation and lubricating means to provide lubrication of the gear means and comprising a circulatory system for circulating lubricating oil through a casing of such gear means, the circulatory system comprising injection means for injecting the oil into the gear means and removing means for removing oil from the casing with maintenance of the level of oil therein at a predetermined height, and feeding means for so feeding an additional quantity of oil to the casing when the rotational speed of the gear means falls below a settable value as to increase the level of oil in the casing to a height permitting splash lubrication of the gear means.

6. Drive means as claimed in claim 5, the lubricating means further comprising a reservoir, the removing means being operable to remove the additional quantity of oil from the casing when the rotational speed of the gear means rises above a settable value thereby to return the level of oil in the casing to the predetermined height and further operable to deliver the removed quantity of oil to the reservoir, and the feeding means being operable to remove oil from the reservoir for feeding of the additional quantity of oil to the casing.

7. Drive means as claimed in claim 6, the removing means being connected by a delivery duct to the reservoir and by a bypass duct to the injection means and the feeding means being connected to the reservoir by flow control valve means.

8. Drive means as claimed in either claim 6 or claim 7, wherein the

reservoir is arranged at such a height relative to the casing as to permit gravity feed by the feeding means from the reservoir to the casing.

9. Drive means substantially as hereinbefore described with reference
5 to the accompanying drawing.

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